



# LinePatrol® Smart Grid Sensor

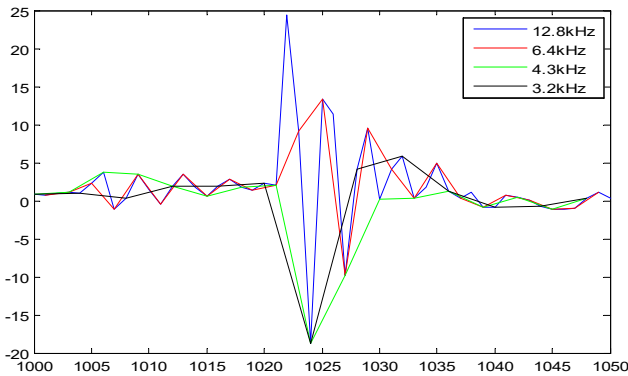
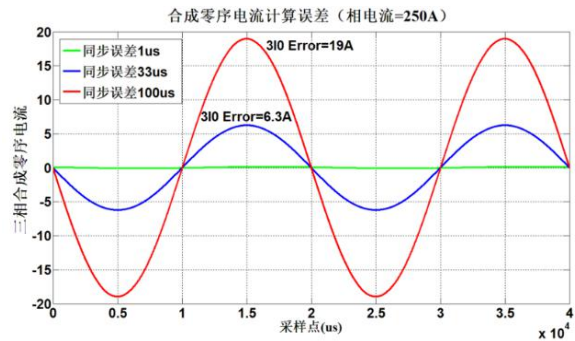
## To Build Eyes & Ears for Distribution Grid



LinePatrol® Smart Grid Sensor (SGS), is an inductively self-powered intelligent device, easy to install and maintenance free. Unlike the traditional power sensors and FCIs, the wide-area timing synchronization and high-precision measurement is introduced in SGS. By providing critical information unavailable previously such as phasors, the SGS helps utilities to gain visibility and improve efficiency for a more reliable grid. The operation cost can be greatly

### 1us Wide-Area Timing Synchronization

SGS can be used to measure power line current, temperature and voltage. All the sampling data from each device have a time stamp and the timing error is within 1 microsecond. It is particularly designed to build a Wide Area Measurement System (WAMS) for power distribution network.



| Sampling Rate | Transient Peak |
|---------------|----------------|
| 12.8KHz       | 24.4A          |
| 6.4kHz        | 13.3A          |
| 4.3kHz        | -18.8A         |
| 3.2KHz        | -18.8A         |

### High Waveform Fidelity

The waveform data is captured at 256 samples per cycle (15,360 samples per second @60Hz, 12,800 samples per second @50Hz) with 16 bits, exceeding the sampling rate of most substation equipment. Therefore, the traditional assembly waveform recorder used in substation can be replaced. It's especially suitable for disturbance event analysis and post fault analysis.

In ungrounded neutral grounding system (UNGS), high precision of timing synchronization, sampling and measurement are critical for Single-Phase Earth Fault analysis, detection and location, which shares 80% of total faults.

Powered by hi-definition waveform data and multiple intelligent algorithms, SGSs working together with SFPlatform can quickly sense and properly identify any abnormality in distribution grid. Any single-phase earth fault generating more than 1A zero-sequence current can be detected and located at nearly 100% rate.



## Applications

- **Load Monitoring:**  
Current, temperature, voltage, harmonics and three phase imbalance
- **Distributed Event Recorder:**  
Capturing and analyzing the unique waveform signature generated by events
- **Wide Area Timing Synchronized Instantaneous Measurement:**  
Real-time power flow state and line loss can be calculated.
- **Power Theft Detection:**  
Power consumption of end users can be monitored.
- **Fault and Pre-fault Identification and Location:**  
Shift utilities from reacting to outages to preemptively tackling issues that may cause real faults in the future

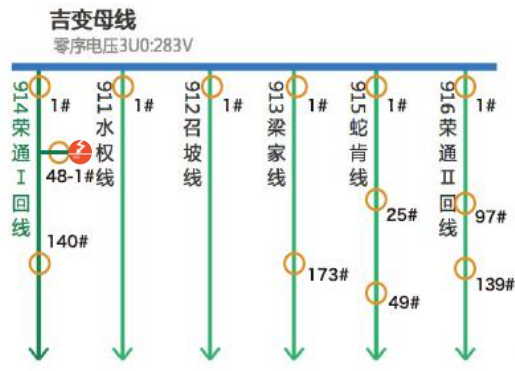
|  |  |
|--|--|
| Off Peak Line Current                          | 6A at full operation                           |
| Conducotr Diameter                             | 8mm-40mm                                       |
| Timing Synchronization                         | 1us  |
| Current Range & Precision                      | 0-100A: ±0.5A,<br>100-600A: ±0.5%              |
| Sampling Rate                                  | 256 samples/cycle                              |
| Waveform Record Length                         | 400ms default<br>(configurable)                |
| Number of Records                              | 1000   |
| Long Distance Communication                    | 2G/3G/4G                                       |
| Dimensions (H*W*L)                             | 220×130x110 mm                                 |
| Weight   | 2.95 kg  |
| Ingress Protection /<br>Flame Retardant Rating | IP66/V0  |
| Installation                                   | Hot stick with no<br>pole-mounted<br>equipment |

## Features

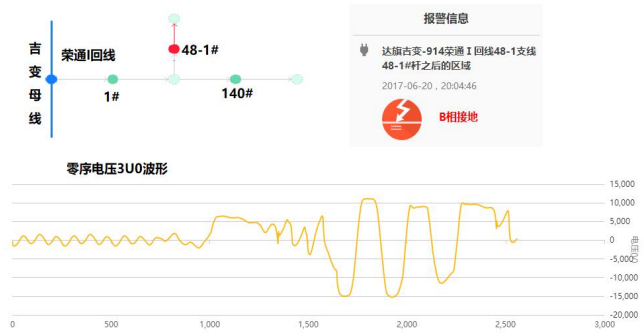
- **Data Synchronization**  
Data from all locations across the distribution network are timing synchronized and aligned with 1us accuracy.
- **Inductively Power Supply & Noninvasive Installation**  
SGS is self-powered and supports noninvasive installation using a hot-stick or hot-glove in a minute. There is no need of extra cable wiring or routing.
- **High Precision & High Sampling Rate**  
Data are sampled at 256 samples per cycle (15,360 samples per second @60Hz, 12,800 samples per second @50Hz) with 16 bits. It is critical for Single-Phase Earth Fault analysis, detection and location.
- **Equipotential Design**  
SGS is equipotential to the power line. There is no insulation risk.
- **Remotely Configurable & Upgradeable**  
SGS is software-defined, over-the-air upgradeable and maintenance free.

### Case: Faulted Line Selection and Fault Location

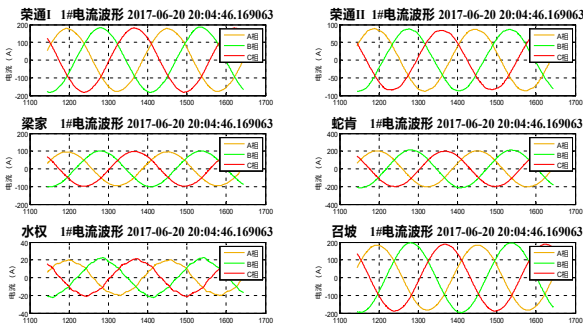
The figure below shows a 35kV substation with six 10kV lines. By analyzing the waveforms of phase current, the zero-sequence voltage and the zero-sequence current, the system automatically outputs the result: B phase earth fault after pole 48-1# of RT I Line @2017-06-20 20:04:46.169063.



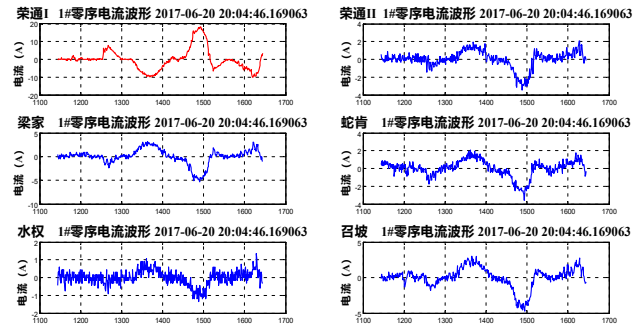
13 SGSs installed covering six 10kV lines



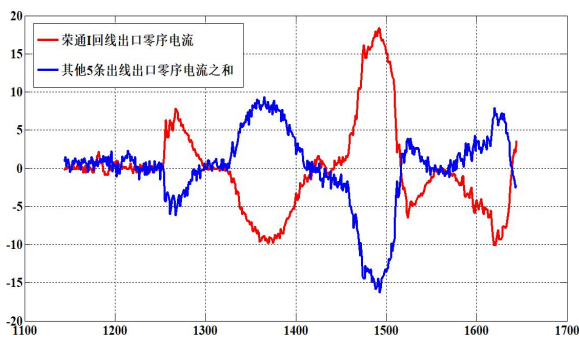
B-phase earth fault located after the pole 48-1# of RT I Line



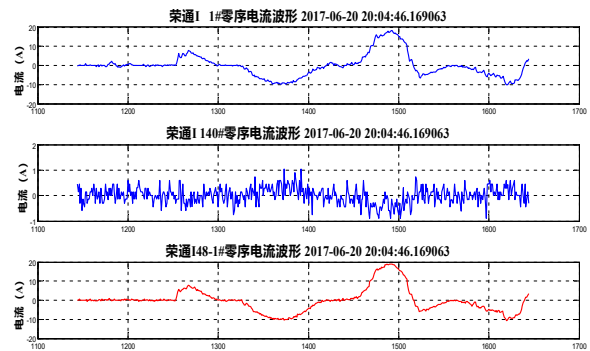
Three Phases Current Waveforms



Zero-Sequence Current Waveforms



**Faulted Line Selection Criteria:** The faulted line zero-sequence current in red is opposite to the other lines in polarity, and equal to the total sum of all the other lines zero-sequence current.



**Fault Location Criteria:** The zero-sequence current waveforms on pole 1# and 48-1# are similar and they are different from the one on pole 140#. Therefore, the fault is positioned after the pole 48-1#.